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ON

GENERATION.

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AN ESSAY
ON
GENERATION.

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TRANSLATED FROM THE GERMAN.

LONDON:
PRINTED FOR T. CADELL, STRAND; FAULDER,
BOND STREET; MURRAY, FLEET STREET;
AND CREECH, AT EDINBURGH.

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THE
Translator's Preface.

THE general curiosity, which has at times manifested itself among Physiologists, to discover the nature of that process, by which the animal part of the creation is formed, and the difficulties which oppose themselves to such researches, might be considered as sufficient motives for

A 3 translating

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(vi)

translating any new work, whose principal view consists in endeavouring to correct some prevailing errors, or to enlarge our ideas in regard to the subject in question.

The following Essay claims our attention in both these respects. It may be considered not only as an attempt at a refutation of one of the most favourite hypotheses on the subject of Generation; I mean that of the Evolution of pre-existing organic germs; but also, as an attempt to establish, upon the basis of experiment, a better, and more consistent theory.

The

The great knowledge and extensive information, which my valuable and learned Friend the Author possesses, not only in physiology, and comparative anatomy, but in every branch of natural history, and, which he has sufficiently evinced in his numerous writings; at the same time, that they prepossess us with the idea, that he is well fitted for such an enquiry, serve also, as a further justification, if a justification be necessary, of the part which I have taken in it. Whether I have executed my task faithfully, I must leave to others to decide.

That

That the conclusions of Spallanzani, whose works may be considered as the chief support of the theory of pre-existing organic germs, require both some degree of restriction, and a more accurate examination, than they have hitherto met with, will appear evident from the Second Section of the following Essay, where the doctrine of Evolution is particularly noticed.

If the admirers of Haller, Bonnet, and Spallanzani, be surpris'd at the manner in which their doctrines are attacked, they are to consider, that
controversy

controverſy never yet injured the cauſe of truth, and that by open and candid examination alone, we are often able to remove the deceptions of prejudice and error. Never did a well-founded theory ſuffer by the moſt ſevere, and critical inveſtigation ; on the contrary, nothing is better calculated to diſcover its value, and eſtabliſh its reputation.

I have only to add, that in tranſlating the compound word (*Bildungsſtrieb*), I have been obliged to make uſe of a Latin expreſſion. The word *Niſus*, which conveys the full ſenſe of
the

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the word *Trieb*, does not appear to have any synonyme in the English language.

A. CRICHTON.

N^o. 10, *Spring Garden*,

Nov. 23^d, 1792.



SECTION I.

*Of the various Hypotheses, by which the
Phenomena of Generation have been
attempted to be explained.*

WHAT is the nature of that change,
which takes place within a female,
when after having experienced the
most delightful of all sensual pleasures, and
being duly impregnated, form, and existence
are about to be given to her offspring?

B

Few

Few questions have ever awakened more general, and more ardent curiosity than this ; for however romantic it may appear to attempt to ascertain the observations, and thoughts of our first parents, yet the supposition is natural, that the wonderful effects, and as it were repeated creations produced by the indulgence of this instinct, must first have excited their surprise, and then led them to a train of reflections.

Considering the innumerable times the phenomena of generation have occurred since the days of Adam, it becomes a humiliating reproach to the understanding of his descendants, that during all that long succession of time, they have not been able to give any satisfactory explanation of the matter ; especially as it appears to have soon become a very early subject of study with speculative men : at least most of the physiological fragments of the ancient philosophers and physicians,

cians^(a), which have been handed down to us, consist in general of inquiries into the mysteries of generation; and indeed since that, there is hardly a period in which the same kind of researches have not been more or less prosecuted.

Even in the darkest times of the middle ages, when the spirit of inquiry seemed almost entirely lost in the lethargy of monastic barbarism, this subject appears every now and then to have awakened a spark of curiosity, and to have stimulated some of the holy fathers of those times to the composition of very sensual and obscene works, some of which have reached our days^(b), and serve to prove

(a) For instance, those of Orpheus, Pythagoras, Anaxagoras, &c.

(b) Such as that of Pope John XXth, or Bishop Albert the Great, or whatever holy father of the church it was, who wrote that vile book *de Secretis Mulierum*. One may also add Mich. Scotus, the scrutinizer of natural things.

that their authors were at least interested in the theoretical, if not in the practical part of generation.

We are not therefore to be surprised, that the attempt to solve this great problem of nature encreased rapidly, beyond the power of numbering, leaving no passage untrod which afforded any hopes of leading to a solution of the mystery; hence there hardly exists another spot in the whole region of natural knowledge, furrounded by more intricate labyrinths, or false guides than this.

Drelingcourt, a teacher of Boerhaave's, collected no less than two hundred and sixty-two vague hypotheses on generation, from the writings of earlier writers.

In spite of the astonishing variety, and number of paths, which seemed to lead to the solution of this physiological problem, yet they are all of them but so many branches of two principal roads; the one conducting to the
doctrine

doctrine of *Evolution*, the other to that of *Epigenesis*.

It is either supposed that the prepared, but at the same time unorganized rudiments of the foetus, first begins to be gradually organized when it arrives at its place of destination at a due time, and under the necessary circumstances. This is the doctrine of *Epigenesis*;

Or, we deny every sort of generation, and believe that the germ of every animal, and every plant that ever has lived and ever will live, were all created at one and the same time, namely, at the beginning of the world; and that all that is necessary is, that one generation should be developed after the other. Such is the celebrated theory of *Evolution*.

But the manner in which this evolution happens, has been differently accounted for.

Heraclitus, furnamed the gloomy, and Hippocrates, or whoever the author of those books on regimen was, which appeared under his name, together with many of their followers, were of opinion, that those germs were scattered up and down the whole globe, where they wandered about, each in search of the genitals of a ready made relation of their own kind, which having once found, they took lodgement there, threw off their envelopement, and now became fit for being themselves evolved.

If we except the imposing name of the authors to whom this theory is ascribed, it has little else to recommend it to our attention. It is so completely built on fanciful suppositions, that it would be difficult to say, what hypothesis might not be credited were we to yield the smallest faith to such a doctrine. The late professor Gesner, who wrote a commentary on this romance of Hippocrates, apologizes for himself by adopting the *bon mot* of Queen Christina, “ that the chi-
 “ meras

“ meras of the ancients were just as good as
 “ those of the moderns.”

More approbation has been given to two other theories of evolution, according to each of which, the germs did not wander about, but those of the same kind were all neatly wrapt up, and encased one within another, so that the first parent of each animal, and plant was supposed to contain all the germs of every succeeding generation; copulation only serving to awaken them to their state of evolution. The only difference between the two theories was, that the one supposed the germs to inhabit the testicles of their father, whilst the other would have it, that they resided in the ovaria of their mother.

No sooner was the art of making magnifying glasses discovered, and by that means an opening procured to a new world in the creation, than the novelty of the discovery, and facility of its application, by af-

fording an opportunity to a number of microscopical experiments, naturally led to the most unexpected fights.

Among the great amateurs of this kind of amusement, was one Ludwig von Hammon, a young man born at Dantzic, who during the time of his studying medicine at Leyden, and in the course of his microscopical pursuits, discovered in the month of August 1677, in a drop of the semen of a cock recently dissected, a kind of ocean, in which swam thousands of little lively active animals.

The same unexpected phenomenon was also observed in the ripe semen of other male animals, and in these animalculæ were immediately thought to be seen, the germs of subsequent perfect animals. By this discovery, a key was supposed to be found, which would unlock the whole mystery of generation.

Now I cannot conceive how some professed philosophers, and natural historians have
been

been led to deny life and voluntary motion to those animalculæ; but I am still more at a loss to imagine, how another set of philosophers have been induced to dignify these animalculæ of a stagnant animal fluid, to the high rank of the organized germs of successive generations.

Without entering into a long and tedious detail of all the doubts and difficulties, which rise up in opposition to so singular a theory, I shall content myself with adding a few reflections, which to the most uninformed readers, will appear sufficient for calling in question this imaginary dignity of the animalculæ of the semen of animals.

How comes it that the animalculæ of the semen of animals the most nearly related, differ so much from each other, whilst scarce any two things resemble one another so much as the animalculæ of animals, the most opposite to each other, both in nature and form?

For instance, the animalculæ in the semen of frogs, as represented by Mr. von Gleichen, bear no kind of resemblance to those of the common newt, as represented by Spallanzani; whereas on the other hand, two drops of water cannot resemble each other more strongly, than the animalculæ of the semen of a man, and those of an ass, as represented by the first of these accurate observers.

This same modern advocate for the dignity of these animalculæ, has already discovered two kinds of them in the same drop of semen of a frog, and yet both of them are perfectly distinct from those which Roesel represents as animalculæ of the semen of the same animal; besides the former were not only discovered in the vesiculæ feminales, but also in the kidneys: mere appearances, as evinced by the irregular and uncertain shape of the inhabitants of the male semen, and which irregularity and uncertainty refutes their pretended dignity so completely, that one might as well
hope

hope with Paracelsus^(c), and the Painter Gautier^(d), to be able to produce a perfect human embryo from male semen, or expect to see, as the famous academician Hartzoeker at-

(^c) *On the nature of things, addressed to John Winkelfteiner von Feyburg at Uchtland, in the sixth volume of Huser's edition of his works, p. 263.*

*Amatus Lusitanas describes a similar production: Vid. Curation, Medicinal Cent. VI. curat. 55, scholi, p. 612. " Certo scimus chemico
 " artificio puerum conflatum esse et omnia sua mem-
 " bra perfecta contraxisse, ac motum habuisse, qui
 " cum a vase ubi continebatur esset extractus mo-
 " veri desit. Novit hæc accuratius Julius Ca-
 " millus vir singularis doctrinæ et rerum occulta-
 " rum, et variarum hac nostra ætate magnus scru-
 " tator et Hetrusca sua lingua scriptor diligentissimus
 " et accuratissimus."*

(^d) *Vide Generation de l'Homme et des Animaux, Paris 1750. 12. Also his Observations sur l'Hist. Nat. 1 p. and the misshapen representation of a fœtus drawn by himself and coloured after life. Tab. A. fig. 3.*

figures us he did, the little embryo fitting in the body of each animalcule, in the same crooked and confined posture as in the female womb^(e).

Long before the animalculæ of the semen were discovered, Joseph de Aromatariis found out a third way to explain the mystery of generation, by means of the theory of evolution; I mean that one which supposes the ovaria of every female, even before impregnation, to contain a whole provision of organized molecules or germs, perfectly ready for evolution.

Swammerdam also adopted this opinion, but owing to the great figure which the

(^e) *Essai de Dioptrique, Paris 1694. 4. p. 230, where the lynx-eyed man gives an accurate figure of a child, which he observed in the body of one of the animalculæ of the semen, and which appeared to him as if anxiously expecting its deliverance.*

animalculæ

animalculæ of the semen soon afterwards made in the world, it remained but little known until two very distinguished authors, Haller, and Bonnet, at once raised its reputation.

According to this theory we, and indeed all the children of Adam, were at one time *ipso facto*, pent up in the two ovaria of our common mother Eve. There we lay, as it were asleep, and although astonishing little creatures, yet completely organized bodies, and perfect miniatures of the forms we have since assumed; for says Haller, “ *All our viscera, and the bones themselves were then already formed, although in a kind of fluid state.*” That which we call impregnation, is nothing else than the action of awakening the germ from its lethargic state by means of the male semen, which stimulates the little creature’s heart to the first pulsation; and so on.

The

The same kind of idea has lately induced a very celebrated naturalist of Geneva, and a warm advocate of this theory, to plan out for us a history of organized bodies previous to the state of impregnation, from which we learn, *first*, that we are all much older than what we suppose ourselves to be, *secondly*, that all mankind are exactly the same age, the great grandfather not a second older than the youngest of his great grand children, *thirdly*, that this respectable age, which we are all of, may be about six thousand years. The same natural historian also agrees entirely in opinion with Bazin; that since that charming long series of years, when we were all packed together along with Cain and Abel, and the other two hundred thousand million of men, which according to the best calculations, have since that period gone *quo pius Æneas quo Tellus dives et Ancus*; in a word, since the first creation, during which time we have been in a kind of lethargic sleep, though not entirely without motion; that
during

during the whole fifty-seven centuries, I say, previous to our being awakened by the above-mentioned stimulus, we were according to Bazin's opinion, always growing a little and little: for instance, we were most probably rather a little bigger at the time we lay beside Cain's nieces, than when all their uncles and aunts were of the party, as it is very natural to suppose, that we must then have been considerably more pinched for room. In this manner our apartment became gradually more easy, and commodious in proportion as our forefathers were evolved, and we agreed with it, for we kept continually stretching ourselves more and more, until the succession of evolution came at last to our turn!!

However extravagant and romantic such conclusions must appear, yet they follow as natural deductions from the premises of the theory, which gave rise to them. In support of this theory, its most celebrated abettors, Haller, and Spallanzani, adduced many experiments, and observations, which we shall
examine.

examine more particularly in the next Section. When we consider how conclusive and striking these observations appear to be at first sight, we shall not wonder at the general assent, which during these thirty years past, has been given to the doctrine of the pre-existence of complete organized molecules in the ovaria of females before impregnation. I myself not only believed in the truth of it, but defended it in many of my writings; so that in fact the present little volume contains a confession of my former errors, in regard to which, I wish that may be true, which Mr. de Luc says some where or other, that, "An error once detected, becomes a more material truth, than many positive ones, which we immediately acknowledge to be such."

The unexpected success of a small experiment, which I made, however, with a view of ascertaining the truth of the doctrine of evolution, first brought me back to the point from which I ought to have set out, and opened.

opened a new road to a very opposite doctrine. He who thus fights with nature, may from an unexpected fight, often discover her most concealed treasures.

What gave occasion to the instituting the experiment was as follows: In one of my walks during some holidays which I spent in the country, I discovered in a stream, a sort of green armed polypus, which differed from the common green kind by its long spiral body, and by having short and rather immoveable tentaculæ. With the wonders of this little animal, I intended to amuse my country friends. The delightful warm summer weather which then prevailed, and the hardy constitution of the polypus itself, favoured the experiments which we made, to discover its power of reproduction so much, that the act of renewal of the parts became almost perceptible. By the second and third day, the maimed and divided animal was so many new ones, each with arms, body, tail, &c.

&c. But we plainly remarked that the regenerated animals, although supplied with plenty of proper food, were always much smaller than before, and a mutilated rump, always diminished very evidently, both in length and diameter, in proportion as the lost parts were renewed^(f).

Soon after my return to town, I was called to a patient who had a caries. The disease occupied the lower end of the femur immediately above the knee, and had caused

(^f) *It is probable that this circumstance has been either totally overlooked by such as were engaged in observing phenomena of greater magnitude in the history of this animal, or if it has been observed by any, it does not seem to have appeared to them, of sufficient importance to be noticed. That attentive, and accurate observer Roessel, however, seems to have noticed this fact. Vide Hist der Polyphen, in the third vol. of the Insecten-belustigungen.*

a pretty

a pretty extensive and deep ulcer. It healed gradually, but in proportion as the wound filled up, and the cicatrix formed, all the surrounding parts sunk so, that the edge of the cicatrix being almost on an equality with the neighbouring parts, the whole formed a broad, though rather superficial excavation^(g). This was exactly the same thing *mutatis mutandis*, with what happened to the polypus.

I have since that period, spent a great deal of my leisure moments in the further investigation of this subject, both in experiment and reflection; the consequence of which has been to convince me fully.

(g) *An observation which has been also made by Messrs. Louis and Fabre, vide their treatises Des Playes avec perte de substance in the Mem. de l'Acad. de Chirurg. vol. iv. p. 64 and 106.*

That

That there is no such thing in nature, as pre-existing organized germs : but that the unorganized matter of generation, after being duly prepared, and having arrived at its place of destination takes on a particular action, or nifus, which nifus continues to act through the whole life of the animal, and that by it the first form of the animal, or plant is not only determined, but afterwards preserved, and when deranged, is again restored. A nifus, which seems therefore to depend on the powers of life, but which is as distinct from the other qualities of living bodies, (sensibility, irritability, and contractility) as from the common properties of dead matter : that it is the chief principle of generation, growth, nutrition, and reproduction, and that to distinguish it from all others, it may be denominated the Formative Nifus (Bildungstrieb, or Nifus formativus).

It is to be hoped, that there is no necessity for reminding the reader, that the expression Formative Nifus, like that of Attraction,

traction^(h), serves only to denote a power, whose constant operation is known from experience, but whose cause, like the causes of most of the qualities of matter, is a *qualitas occulta* to us⁽ⁱ⁾. We may say of this, as of all

(^h) *Vid. Newton at the end of his Optics:*
 “ What I call *ATTRACTION*, may be performed
 “ by *IMPULSE*, or by some other means unknown
 “ to me. I use that word here to signify only in
 “ general any *FORCE* by which bodies tend to-
 “ wards one another, whatever be the *CAUSE*.”

(ⁱ) *Qualitas occulta*—“ *Se l'on entend par ce*
 “ *mot un principe reel dont on ne peut rendre raison*
 “ *tout l'univers est dans ce cas.*” &c. says Vol-
 taire, *vid. his Elemens de la Philosophie de Newton.*

And in another place he further adds, “ *Il*
 “ *falloit respecter les qualités occultes ; car depuis*
 “ *le brin d'herbe que l'ambre attira, jusqu'à la*
 “ *route que tant d'astres suivent dans l'espace ;*
 “ *depuis la formation d'une mite dans un fromage*
 “ *jusqu'à la Galaxie ; soit que vous considerer, une*
 “ *pierre qui tombe, soit que vous suiviez le cours*
 “ *d'une*

all similar powers, what Ovid says:—*Causa latet, vis est notissima*. But the great merit in the study of these powers, is to ascertain more accurately their effects, and to reduce them under general laws^(k).

D'Alembert's successor, Mr. de Condorcet, in his Eulogy on Haller, and when speaking of Irritability, says, " The truth of
" this doctrine was, as usually is the case, at
" first denied; but when it was discovered,

" *d'une comète traversant les cieux tout est qualifié*
" *occulte.*"

(^k) One of the most learned, and ingenious English physicians of the present time, Dr. G. Fordyce, has very lately said, in treating a physiological point something similar to this, " Although the
" study of causes of original powers be totally absurd
" and futile, yet the laws of their action are capable of investigation by experiment, and applicable to the evolving much useful knowledge."
Philosoph. Transf. V. LXXVIII. P. 1. p. 36.

" and

“ and that could not be done any longer with
 “ honour, they concluded with observing,
 “ that it had been discovered long before !”

When it is considered that some people have been lately possessed of sufficient penetration to discover the doctrine of irritability in the writings of Homer, and the circulation of the blood described in the books of Solomon the Preacher; it would be really astonishing if this doctrine of the Formative Principle were allowed the merits of novelty, and that nothing of the kind were to be discovered in all the works which have been written on the subject within these two thousand years past⁽¹⁾; especially as the *Vis Plastica*

(1) No one has given such a clear proof of this as Ad. Mich. Birkholz, Philos. et Med. Dr. et Facult. Med. Assess. in his *Dissert. de Respiratione ejusque fine summo atque ultimo*, Lips. 1782. After informing us, that the animal spirits (*Spiritus vitales*)

Plastica of the ancients, and more particularly of the peripatetic schools, would seem as far as the concordance of name goes to attempt one to such a *qui pro quo*.

vitales) which the blood derives from the air, is nothing more than the *principium vitale* of the ancients, or the irritability and sensibility of Haller, he adds, “ *Veteres philosophi hoc principium agnoverint*
 “ *vicarium Dei ministrum et presidentiam superioris*
 “ *agentis, et apud Græcos quidem sub persona Jovis*
 “ *colebatur: Jovis omnia plena! a vetustissimis phi-*
 “ *losophis, a Platone, et platonice Arabibus, et le*
 “ *Cat, appellatur anima, spiritus et idea mundi, vis*
 “ *et natura genetrix et plastica, ideæ operatrices: a*
 “ *Rayo flamma vitalis; ab eodem et postea imprimis*
 “ *a Newtono principium trahens: a chemicis humi-*
 “ *dum radicale, et quintum elementum: a Colonne*
 “ *invisibilia fermenta: a Blumenbachio nifus for-*
 “ *mativus. A philosophis Hermeticis mercurius*
 “ *universalis et philosophorum: a Thouvenel Gas*
 “ *Aëroelectricum, ab aliis aliter appellatur.*”

I should

I should be extremely happy, however, if any person would name one of the old writers, who, in describing the *Vis Plastica*, has given such a distinct idea of it, or such a one as corresponds so well with the phenomena of generation^(m), as that which I have attempted to give (especially in the Third Section) of this Essay.

(^m) *Of all authors who have treated of this power, F. Bonamica, the well-known disciple of Aristotle, explains himself perhaps the most correctly, de formatione fœtus, p. 528. “ Spiritus
 “ in ærea seminis substantia comprehensus, aspersus
 “ autem a calore cœlesti, et vi a patre accepta, et
 “ ea quam a cœlo participat in uterum fœminæ con-
 “ jectus, concoquet materias a fœmena infusas,
 “ et pro ratione ipsarum variis modis afficiens efficit
 “ instrumenta. Dum vero ea fabricat appellatur.
 “ Facultas διαπλαστική seu δημιουργική. Sed ubi ex-
 “ tructa fuerint instrumenta, ut iis uti queat, quæ
 “ prius erat vis formatrix, illis utens degenerat in
 “ animam.”*

Professor Wolff of Petersburg, a physiologist of great penetration, hath explained the growth of Animals, and Vegetables by another power, which he calls *Vis Essentialis*, and which one on first hearing, might be apt to confound with the *Nisus Formativus*.

Whoever takes the trouble, however, of perusing the sentiments which Professor Wolff entertains of the *Vis Essentialis*, as given in his *Theoria Generationis*, will soon discern the great difference there is between the two⁽ⁿ⁾.

According

(ⁿ) For example, p. 12. “ *Vis vegetabilium*
 “ *essentialis ea est vis, quâ humores ex circumjacente*
 “ *terra, vel aliis corporibus colliguntur subire radicem*
 “ *coguntur, per omnem plantam distribuuntur, par-*
 “ *tem ad diversa loca deponuntur, partem foras*
 “ *expelluntur.*”

P. 13. “ *Quæ cunque vero sit hæc vis, sive*
 “ *attrahitrix, sive propulsiva, sive æri expanso debita*
 “ *sive composita ex omnibus hisce et pluribus; modo*
 “ *præstet*

According to him the *Vis Essentialis* is only that power, by which the nourishment is distributed to the different parts of an animal, or vegetable. This is, indeed, necessary to the Formative Principle; but it is quite distinct from the principle itself. For this

“ præstet enarratos effectus, et ponatur, posita plantæ
 “ et humoribus nutritiis applicatis, id quod experien-
 “ tia confirmatum est : sufficiet ea præsentī scopo et
 “ vocabitur a me *Vis vegetabilium Essentialis* :

And in respect to the generation of animals,
 p. 73. “ Embryonem hoc tempore (ovo sc. 36. horas
 “ incubato) ex substantia ovi nutrire demonstrant il-
 “ lius volumen auctum, perfectiones acquisitæ, absen-
 “ tia cujusunque alius materiæ consumptio alluminis et
 “ vitelli succedens, experimenta inferius recensenda ;
 “ consequenter : transire particulas nurientes ex ovo
 “ ad embryonem : et existere vim quâ id perficitur
 “ quæ non est systaltica cordis et arteriarum, neque
 “ hinc facta pressio in venas vicinas neque harum
 “ compressio a motu musculorum, dirigentem absque
 “ canalibus viam determinantibus, adeoque analogam
 “ illi (§. 1.) quam æque vocabo essentialem.”

Vis Essentialis exerts itself with equal force in the growth of even the most deformed, and unnatural excrescences of plants, and trees, &c. where the Formative Principle does not seem to act at all, or at least with no regularity.

On the other hand, the *Vis Essentialis* may be very weak, or deficient, as in such organized bodies, which are badly nourished, whilst the Formative Principle remains in full force, and so on.

However unpleasant it may be to me, yet I feel myself forced, before entering more particularly on the nature of the Formative Principle, to premise a refutation of the arguments which have been brought, and especially by Baron von Haller, in favour of evolution of the female egg^(o). What consoles

(o) But in doing so, I shall pass over all those arguments against the doctrine of evolution, which

foles me, however, in being thus obliged to dissent from the opinions of a man, to whose works and writings I owe so much, is, partly the reflection, that whatever useful may be contained in the present sheets, was occasioned by examining into, and prosecuting his enquiries, and partly my doubts whether he himself might not have altered his ideas, and have relinquished, in a great degree, his old opinions on the subject, had he lived to have finished that part of the last edition of his Physiology^(P), which treats of this matter.

Indeed,

which have lately appeared in a most ingenious and witty publication, written expressly for that purpose. Vide Doubts concerning the Theory of Evolution, in a letter addressed to Mons. Senebier, from L. P. (Patrin) translated from the original French manuscript into German by G. Forster, Goettengen, 1788.

(P). He himself wrote me a letter, dated the 28th August 1776, in which he says “ I thank
“ Providence for having granted me so long a life

Indeed, had Haller still persisted to support the doctrine of evolution, and oppose that of gradual formation, his fame would have suffered as little from it, as Harvey's from his denying the existence of the lacteal vessels, or Newton's from his disbelief of the possibility of colourless tubes in the fern.

*“ as has enabled me to give an improved and
 “ corrected edition of my Physiology, without which,
 “ I must have left many errors to be detected after
 “ my death.”*

SECT. II.

Examination of the principal Arguments in favour of the supposed Pre-existence of Organized Germs in the Ovaria of Females, and Refutation of the Doctrine.

ON the 13th of May 1758 was read before the Royal Society of Sciences at Göttingen, the celebrated paper of Baron von Haller, (then president of the society) on the formation of the heart in the embryo, in which it was believed an *argumentum crucis* was offered in support of the doctrine of pre-existing germs. The author says, That he found that not only the membrane of the yolk of an incubated egg, but also its blood-vessels, constituting what was called the *figura venosa*, were a continuation of the membrane and blood-vessels of the chick.

But the yolk of the egg existed in the hen previous to impregnation, and therefore most probably the embryo also, although too small to be discovered by our eyes. The prudent author however expressed himself at first very cautiously and in an undecided manner on this syllogism⁽¹⁾.

Monf. Bonnet, however, who soon after published his work on organized bodies, and, who was previously prepossessed in favour of the doctrine of the evolution of pre-existing organic germs, took hold of this observation of Haller's, and pronounced it to be absolutely unanswerable, and considered the truth of the hypothesis as fully established by it⁽¹⁾.

Haller

(1) “ *L'evolution commence à me paroître la plus probable.*”

(1) *Vide his preface to the work alluded to.*
Ed. 5th. “ *Enfin cette decouverte importante*
“ *(que le germe appartenoit à la femelle, qu'il pre-*
“ *existoit*

Haller also allowed himself to be daily more and more convinced of the force of his own observations, infomuch that in his later writings he made little scruple of declaring them equally decisive, as his friend Bonnet had done.

“ existoit ainsi a la fœcondation, et que l’evolution
 “ étoit la loi naturelle des etres organisés) que
 “ j’attendois et que j’avois osé predire me fut an-
 “ noncée en 1757, par Monsf. le Baron de Haller
 “ qui la tenoit de la nature elle même.” La
 “ decouverte de Mr. de Haller prouvoit d’une ma-
 “ nière incontestable que le poulet appartenoit ori-
 “ ginairement à la poule et qu’il pre-existoit à la
 “ CONCEPTION.”

And in his letter to Mr. von Haller, dated 30th of October 1757, he says, “ Vos poulets
 “ m’enchantent : je n’avois pas espéré que le secret
 “ de la generation commonceroit sitôt a se dévoiler.
 “ C’est bien vous, Monsieur, qui avez sçu prendre
 “ la nature sur le fait.”

In acknowledging that I myself, as well as some hundred other physiologists, and naturalists, looked on this celebrated observation as the foundation stone of the theory of evolution; I think I need make the less ceremony in expressing my astonishment how we could have allowed ourselves, as in the present case, to attribute so much force to an assertion which absolutely proves nothing!

For, granting it to be fully proved that there existed a continuation between the membrane and vessels of the chick and yolk, (granting it, I say; for, the fact as the most accurate, and scrupulous investigation teaches, still remains uncertain, as every one will readily acknowledge who has taken the pains of examining fecundated eggs,) yet it does not follow that the membrane and vessels, even if they really were a continuation of each other, co-existed from the beginning. Do we not see many instances in organized bodies where this last mentioned circumstance exists, and yet where it is impossible to grant the

the supposition which has been drawn as a conclusion from it. For instance, all those singular vegetable productions, which are caused by the puncture of certain insects in many plants. Thus the *Spongiæ cynosbatæ* are produced entirely in consequence of the puncture of the *Cynips* in the rose-bush. The bark of this shrub is continued over this spongy and quite *accidental* production; nay, if we take, and cut any fresh branch which has some of these spongy bodies on it, we shall find that the wood of the branch appears to be an evident continuation of the woody part of these substances. But shall we from hence conclude, that this accidental production originally co-existed with the shrub itself, and that in every trunk, and every branch of every rose-bush in the world, the enveloped germs of innumerable *spongiæ cynosbatæ* should have always lain there like so much hidden wealth, and would have always remained so until the thousand thousandth part of them were by chance excited

to evolution by the benevolent puncture of a little cynips.

Again, in the animal kingdom, do we not often see after an accidental inflammation of any of the viscera, a new membrane formed as it were by the effusion of the lymphatic part of the blood; and in the course of a few days, do we not observe many blood-vessels produced in this membrane, which anastomose with the blood-vessels of the neighbouring viscera; and yet it would be ridiculous to suppose that these vessels co-existed from the first with the old ones. And for fear that it be objected to us, that these are mere preternatural appearances in the diseased state of animals, we beg them to recall the late celebrated *membrana decidua* of Dr. Hunter, which after a fruitful impregnation, lines the whole cavity of the uterus, and whose blood-vessels, especially where the umbilical chord is inserted in the placenta, are most evidently connected
yet and

and anastomose with the blood-vessels of the mother.

In all these cases, the new formed membranes, and their blood-vessels are the mere productions of the neighbouring viscera, which renders it probable, that the membrane and vessels of the embryo in a fecundated egg, are produced in like manner from the membrane and vessels of the yolk.

Mr. Paul^(s), a natural historian of great penetration, hath objected to Haller's demonstration, that allowing the membranes of the yolk with its invifible vessels to have pre-existed in the hen, yet it is possible that the embryo is only formed during incubation, and that its blood-vessels afterward unite with the blood-vessels of the membrane of the yolk, and thus form an anastomosis.

(^s) *In the preface to the 8th vol. of the Collection Academique par etrangere, p. 22, sqq.*

Baron

Baron von Haller immediately declared loudly against this objection, and denied it altogether as a thing *impossible*, that the tender vessels of the microscopic embryo should be capable of anastomosing with the large blood-vessels of the giant yolk^(t).

But what is rather singular, is, that this same most ingenious and meritorious author, who denies the possibility of such an anastomosis, supposes without any hesitation, and in the same work^(u), when explaining human conception, that the very minute germ as soon as it has arrived at the cavity of the uterus, forms an adhesion with it by

(^t) “ *Nunquam fieri potest ut inter tubulum
“ millionesies minorem, et millionesies majorem con-
“ tinuitas oviatur.*” *Element. Physiol.* T. VIII.
P. 1. p. 94. compare with his first lines of *Physiology*, § 883, and with the *Opera Minora*, T. XI. p. 419.

(^u) *Elem. Physiolog.*

means of its placenta;—And how? Just in the same way that he denies it to the embryo of the hen; that is to say, by an anastomosis taking place between the microscopic and tender branches of the umbilical vessels, and the giant ones of the maternal uterus.

The modern advocates for the theory of evolution, have taken this observation of the yolk of the egg, as the prop of their hypothesis.

Long before this however, the spawn of the frog had been employed for the same service.

Near a century indeed before that period, Swammerdam announced the wonderful discovery, that the black points in the spawn of a frog were so many perfectly formed little frogs, and that they pre-existed in the ovaria, although not to be discovered by the eye^(w).

The

(^w) *Miracul. Natur.* p. 21. “ *Admirabile*
 “ *dignum est, nigrum illud punctum, quod in ovis*
 “ *ranarum*

The good man seemed to have had a pre-sentiment of the uncertainty and instability of all vain worldly honours, and he therefore, as is well known, soon after betook himself to a more solid mysterious enjoyment, in which Mlle. Bourignon bore a part. And, indeed, it happened as he appears

*“ ranarum videre est, ipsum ranunculum omnibus
 “ suis partibus absolutum; albicantem verum et
 “ circumfusum illum liquorem non nisi alimentum
 “ ejus esse; quod ipsum sensim dilatatum ita at-
 “ tenuatur, ut exire cum velet possit,” &c.*

*“ Magis mirum est hunc ipsum ranunculum in
 “ ovaris usque adeo exiguum ortus et incrementi sui
 “ principium habere, ut fere visum effugiat, ut
 “ ipsum animal sub hac tantula mole deliteat.”*

And a little way further on, he draws the general conclusion; *“ Nullus mihi in rerum naturæ
 “ generationi, sed soli propagatione vel incremento
 “ partium locus esse videtur ubi casus omnis exclu-
 “ datur.”*

to

to have foreseen; for the ungrateful world now ascribe the merits of that discovery to the celebrated Abbé Spallanzani, who has maintained it in several of his writings, but more particularly in the second volume of his *Essays*(^x).

He calls the little black points of the fecundated spawn of frogs, Tadpoles, or young frogs(^y); and as this little black point exactly resembles the same in the unfecundated spawn(^z), he reasons agreeably to his logic,

(^x) *Dissertazioni di fisica animale e vegetabile*, T. XI. in Modena, 1780, 8.

(^y) “ *A parlare filosoficamente l'uovo non è che il gerino in se stesso concentrato, e ristretto, il quale mediante la fecondazione si sviluppa ed acquista le fatezze di animale.*” p. 11. § XVII.

(^z) “ *Questi globetti non fecondati non sono per verun conto distinguibili dai fecondati.*” § XVIII.

that

that the tadpoles must have existed in the mother^(a).

I do not know what would be thought of that chemist who asserts that the Arbor Dianæ pre-existed in a mass of Amalgam of silver, because when a weak solution of silver was poured on it, a little tree seemed to spring out of it.

One ought to be ashamed of wasting much time in the refutation of an assertion, the falsity of which any unprejudiced person who is not altogether unaccustomed to observations of the kind may convince himself of every spring.

(^a) “ *Ma i globetti fecondati non sono che i
“ feti ranini, § XVII. Adunque i globetti non
“ fecondati lo saranno altresì; e conseguentemente nella
“ nostra rana il feto esiste in lei pria che abbiasi
“ la fecondazione del maschio.*” p. 12. § XIX.

Whoever

Whoever has taken the trouble, accurately, to examine the spawn of the frog must confess, that the idea of demonstrating the little black points contained in it to be so many complete formed tadpoles, partakes greatly of Brother Peters's method of reasoning in the Tale of the Tub, where he demonstrates to his brothers that the brown loaf is a piece of excellent roast mutton.

But the abettors of the theory of organized germs have gone a step further in support of their opinions. They refer to cases where even young girls, in all their maiden innocence, have become pregnant from the untimely, and premature evolution of one of these organized germs.

The concurrence of facts is sometimes most wonderful. It happened that in the very same year that Swammerdam announced his discovery in the spawn of the frog, that a case was published in the *Ephem. rerum. nat. curios.*
delivered

delivered to the society by a celebrated court-physician of those times Dr. Claudius, which exactly suited as a confirmation of Swammerdam's opinion.—A miller's wife was delivered of a little girl whose belly seemed of an unusual size. Eight days afterwards this little big-bellied child was seized with such violent pains and restlessness, that every one who was present thought it could not outlive the next instant. The sick infant however in the mean time actually bore a well-formed, elegant, lively, little daughter about the size of one's middle finger, which was regularly baptized. During the time, and after the birth, the waters, placenta, and all other impurities were rightly discharged. But both the little mother and daughter died early the following day^(b).

Baron

(^b) *I adopt the very words of a contemporary physician, Dr. Otto, who was consulted by the grandmother (the miller's wife) during her pregnancy*

Baron von Haller very judiciously classes this case with another from the Transactions of the Academy of Sciences of Stockholm, where on dissecting a young girl, bones, teeth, and hairs were found in a tumor of the mesentery. These two cases he looks on as principal evidences for the truth of the doctrine of germs pre-existing in the mother.

In Schmucker's Miscellaneous Surgical Essays an anonymous correspondent sends the history of the dissection of a girl, in whom, instead of an uterus, there was found a hard hairy body of the size of a large walnut, and

nancy. His nephew has vindicated and illustrated the whole history in a most learned and subtle manner. D. C. J. Aug. Ottonis Epistola de fœtu puerpera sive de fœtu in fœtu. Weissenfels, 1748. 8vo.

That this extraordinary history is also well calculated to interest the casuist is evident, from the Disquisitionum filiola, quam acto dierum enfans vivam enixa est baptismi capax?

which

which resembled an ill-shaped head. It had two perfect teeth, and contained in its cavity something like brain.

Now since the abettors of the theory of evolution so loudly remonstrate against, and complain of the unfair method of proceeding by opposing mere argument to the facts which they bring forward in support of their opinions, I shall for the present totally abstain from all reasoning, and endeavour to satisfy these gentlemen by adducing fact for fact, observation for observation, and those of no less wonderful, and entertaining a nature than theirs; for they will prove, that not only men but male animals have been equally in a thriving way with young virgins; and I trust the testimonies of the truth of these stories will be found equally respectable with those of the opposite party.

To the case extracted from the Memoirs of the Academy of Stockholm I oppose one from the History of the Royal Academy of Sciences

Sciences of Paris, where an Abbé was interrupted very *mal apropos* whilst instituting some experiments on generation. He was alarmed by an extraordinary encrease of bulk in a certain part, which another Abbé (the unfortunate Abelard) was deprived of in consequence of a similar experiment.

The tumor encreased so much that he was obliged to submit to an operation, and his surgeon assured the academy that he cut an ossified child (c) from the part.

To the story of the miller's wife I beg leave to subjoin one from the Philosophical Transactions of London, where an account is given of a male greyhound that bore a living puppy *per anum*; and in the place of Drs. Otto and Claudius, who witnessed the truth of the first fact, I shall mention two names of

(c) “ On y distinguoit la tête, les pieds, et les yeux.”

which

which England ought to boast: Dr. Wallis, and Edmund Halley.

Lastly to the anonymous in Schmucker I oppose an anonymous in the works of the respectable Fr. Ruysh, who was presented with a similar production. It was a bony case, half as big as a common walnut, together with four perfect *mollares*, and a knot of hair, which, he assured the doctor, he had cut from the stomach of a male subject.

Thus I have adduced authority for authority; nor do I believe it possible for any one to go more conscientiously to work than I have done; and so far therefore I trust we are quits.

Were I allowed however to speak my mind freely on this matter, I should advise all such auxiliary troops to be withdrawn. My only reason for bringing them on the field was merely to oppose those of my antagonists.

These

These therefore are the principal arguments, which, I have to oppose to what the advocates for the theory of evolution consider as the strongest, and most decisive proofs of their theory.

But experience supplies me with another source of facts, which may be used as arguments against this theory, and which, to unprejudiced, and judicious readers, ought to be sufficient whereby to ascertain its true degree of probability.

For instance, the well established, and universal truth ; that the first appearance of a newly conceived animal, or plant, is never to be discovered immediately on impregnation, even by the most powerful armed eye ; no such thing is to be seen until a considerable time has elapsed.

It is not worth while to enter into a refutation of the fabulous assertion of Hippocrates, and of so many others of his old and worthy followers, that perfectly distinct, and well

D formed

formed human embryos were to be seen in the very first days of conception. Considering the few aids, and little opportunity they had in those days of making such observations, great allowance is to be made; and the more so, when we consider that even modern physicians of much more extensive experience in these matters, have been guilty of similar assertions. Mauriceau has amused us with representations of fœtusses of one day, and of three days and a half, &c. and Malpighi and Croune have assured us that they had seen the embryo of the chick and its appendices in the egg of a trod hen before the egg had been fate upon. The last author indeed observed it, he says, in the addle egg of hens that never had been cocked.

It is impossible however to discover any thing before the third week after conception, which any cautious and creditable observer would presume to pronounce a human embryo, and in the fecundated egg nothing can be observed, which has even the most distant resemblance

resemblance to a chick in the first twelve hours, nor indeed until the end of the second day. Previous to this period of time peculiar to each animal, and vegetable, (d) it is quite impossible to distinguish the newly conceived offspring; which circumstance, considering the perfection, and powers of our microscopes, is by no means favourable to the theory of evolution.

Nor, is it at all easy to comprehend how the advocates for that theory make the phenomena of the accidental origin and growth of certain preternatural parts agree with their doctrine of pre-existing organic germs.

A few instances of this kind will serve instead of many.

(d) *In the hare the first traces of the young are not seen until the ninth day; in the sheep not before the nineteenth; in the deer not before the seventh week.*

A woman conceives, but the foetus instead of being in the uterus, is situated in one of the Fallopean tubes. The tube at last bursts from the increase of bulk of this strayed animal, and it falls into the cavity of the abdomen. What does nature do? She pours out a quantity of plastic lymph, which forms itself evidently into organized membranes, incrusting and enveloping the foetus like a mummy, by which it is prevented from putrefaction; for were this allowed to take place, it would occasion certain death to the mother, but who, preserved by this contrivance, is enabled to carry the troublesome, though not dangerous load, for a considerable number of years. On opening the body after death, we evidently perceive this new, and, accidentally formed membrane, to be richly supplied with blood vessels, ^(e) which

(^e) *In the eighth volume of the Commentaries of the Royal Society of Göttingen I have given the description of a foetus of this kind which had lain*
eight

which it would be rather difficult to prove, had pre-existed in the organic germ.

A person breaks both bones of the forearm, but is so restless as to disturb nature in her usual process of healing them, that is, by means of a new ossification. In this case what does she do? She forms a new joint of the broken ends of both bones; making as it were a second elbow which can be moved at pleasure without any assistance from the other hand.

Another person dislocates his thigh bone from its natural situation in the Ilium, and nature endeavours to remedy the evil, by forming a new socket for it^(f).

eight years within the mother. This specimen was presented to the Museum of the Academy by my very worthy friend Mr. Buchner of Gotha.

^(f) *In my Osteology I have given numerous examples of this, vid. page 43.*

A child is born with a hydrocephalus, occasioned by mere accidental circumstances; such for instance as the frequent, and too violent connection of the father with the mother, during the time of her gestation. Owing to this disease, the cranium becomes preternaturally distended, and immense spaces are left between the very thin, and greatly distended bones. In order to remedy this, nature forms detached osseous points in these interstices, which points, at last become true *ossa triquetra*, filling up all the dangerous voids, and uniting all the bones of the head together.

These *ossa triquetra* however do not belong to the natural structure of the foetus, and are very seldom to be met with in the skulls of savages, or of brute animals. It is hardly possible therefore that they should have pre-existed in the organic germ: and yet they are as perfect bones as any others of the head, having true, and well formed sutures. The sutures of these bones are not always locked
in

in with the futures of the other bones of the head; but it often happens, that they are so numerous, and so thick together, that those in the middle evidently construct their own ones. What is there however which exhibits more art than the structure of a true future; its double, nay treble row of teeth, the corresponding depressions, and the astonishing manner in which they are clasped together?

The conclusion which naturally follows, is, that if perfect bones, new and preternatural joints, new organized and vascular membranes can be formed, where there was no ground for supposing a pre-existing germ, what necessity is there for this doctrine of envelopement?

But the phenomena which occur in the generation of mules, so completely refute all our ideas of pre-existing organic germs, that one is at a loss to imagine, how, after a due attention to this subject, such a theory should

have found any serious abettors. I should suppose that a single experiment, such as that of Mr. Koelreuter, who by repeatedly producing prolific bastard plants, transformed one species of tobacco (*nicotiana rustica*) into another (*nicotiana paniculata*) so completely, that it had not the smallest resemblance to its maternal parent; that such an experiment, I say must cure the most partial advocate for the theory of evolution, of his error. This excellent observer, by artificially impregnating the first species of tobacco with the farina of the last mentioned, obtained prolific bastard seeds from it, and with the plants which sprung from these, he repeated the same experiment, impregnating them with the farina of the *Nicotiana paniculata*. As the plants which he procured from the seeds of this last combination, differed more from the original maternal plant, he repeated the same process with it, and proceeded to do so with every new offspring, untill he obtained six plants, which in every respect appeared perfectly similar to the *paniculata*; so that in the classical work,

in

in which he gives a narrative of this, he appears perfectly justifiable in entitling it, *A complete metamorphosis of one natural species of plants into another.*

I know perfectly well, that the favourers of the theory of evolution endeavour to explain the production of bastards, or mules, by saying, that the male semen, besides its stimulating power of awakening the female germs from their state of stupor, and inactivity; also ascribe to it certain *formative* powers, by which the germ may be altered in a certain degree, so as to resemble the father a little. But what in the name of Heaven is such a subterfuge than the silent acknowledgement of the insufficiency of the germ theory, and of the necessity of having recourse to formative powers, in order to extricate it? If these formative powers, however, are so strong as totally to change the structure and appearance of the maternal germ, and that in the course of a few generations, it is rather difficult to conceive the utility of such a theory.

1. The first part of the paper discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is essential for the proper management of the company's finances and for ensuring that all stakeholders have access to the same information.

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SECT. III.

*Proofs of the Formative Nifus, and an Attempt
to ascertain some of its Laws.*

IT is easier to overturn, than to establish a theory; and the reproach has been often applied to old reformers, that they have succeeded better in attempts of the first, than of the last kind. Yet what Mons. Bonnet excellently remarks on this subject may be very true^(g), that the detection of an error is often of greater consequence than the discovery of

(g) *Demontrer une erreur, c'est plus que découvrir une vérité : car l'on peut ignorer beaucoup ; mais le peut que l'on sçait, il faut au moins le savoir bien. Preface de l'Essai sur l'ame.*

a new fact. In this respect therefore, I trust the present sheets will at least be allowed some merits, since they point out the defects of a late beloved, and almost universally adopted theory. I hope, however, at the same time, that the one which I give in its place will be found more agreeable to what we observe in nature.

No one can be more fully persuaded of the immense gap which exists between the organised, and unorganised, between the animated, and the inanimate world, than I am ; and although I have the greatest respect for the penetration of those who discover a gradual scale of ascent and descent in the works of nature, yet I confess I am at a loss to guess how they make it pass from organic to inorganic bodies. Such a reflection, however, ought by no means, to deter us from employing the phenomena of either of these classes of bodies for explaining the phenomena of the other : and so far do I consider it as an argument, not of the least importance, for
 proving

proving the existence of the Formative Nîsus in organic bodies, that even in the inorganic ones there exists traces of a Formative Power; not of a Formative *Nîsus* however, at least, in the sense this word is used in this work; for here it is considered as one of the properties of the living principle, and consequently not to be imagined as belonging to dead matter: but that this last Formative Power is demonstrated by the regularity and invariable shape of certain bodies which we find to be formed of it.

For only to adduce one or two instances, we find nothing more elegant, than certain metallic crystallizations, which as to their external aspect, bear so striking a resemblance to certain organized bodies, that they become a very good example for explaining to us the manner in which bodies are formed from rude and unorganized matter. Such for instance, is that species of native dendritical silver, imbedded in a matrix of quartz from Mexico, *Farnkrautsilber*, and which resembles the foliage

liage of the fern, or to name something more common, that undescribable beautiful moss-looking texture of brass, which is observed in breaking a piece of it, after the first fusion.

These as I have already said, are adduced as mere examples of the existence of a Formative Principle in unorganized bodies.

And now for the true formative effort in the animated world.

I know no means so well calculated for rendering the existence, and activity of this nifus evident to an impartial eye, as to observe the origin and progress of such organized bodies, which increase so rapidly in bulk, that the action of the growth becomes almost evident; and which are of so delicate and semitransparent a texture, as to be capable of being evidently seen through with the assistance of a microscope, and a due degree of light.

The

The vegetable kingdom supplies us with a very good example of this kind, in the simple production of a most simple water plant, (*conferva fontinalis*) which is commonly to be met with every spring, in wells, ponds, and springs, or in the wooden pipes through which water flows.

The whole plant consists of a single uniform straight fine thread, of a bright green colour, and about half an inch in length, and whose under extremity is generally inserted in a bed of slime. As these threads, however, are extremely numerous, and grow very close together, they look like a very fine fur of the most beautiful green colour, with which considerable spaces of the places above mentioned are sometimes covered.

I have attentively observed the propagation of this water plant in the beginning of the spring, and to me it appeared to take place in the following manner. The upper end
of

of the fibrile began gradually to swell, and divide into a number of small round points, which at last disengaged themselves from the parental thread, and in the number of some thousands, attached themselves to the sides of the glass in which I made the experiment. Soon afterwards, these round bodies began to shoot out a small point, which almost visibly lengthened till they had acquired their due size. All this took place in the space of twice twenty-four hours, counting from the first moment that the end of the old thread began to swell.

Both the rapid growth of this plant, and its transparent texture, afforded me means of discovering not only its structure, but also the slightest changes that took place in it. This kind of moss is equally simple internally, as externally; and under the strongest magnifying powers, and by the best light, we can discover nothing else than a fine vesicular appearance, like a green froth, surrounded by a very thin delicate membrane.

But

But in spite of the distinctness of texture of the little green points which adhered to the sides of the vessel, there was nothing to be seen like the germ of an enveloped filament in them, such as was soon to be produced from it: but only when the little round body had attained a certain degree of perfection, a small shoot seemed to spring out of it, in such a manner, that its act of evolution seemed to be promoted merely by that part of the vesicular texture of the round point, which was most contiguous to the filament, passing gradually over to it. As the filament encreased in length, the little round body gradually decreased in magnitude, and became of a paler colour, so that at last, when the filament had arrived at its full growth, there remained just a perceptible swelling at the inferior end, and which served as a root to the new filament.

With an equal degree of distinctness with which the progress of the Formative Nifus of this plant becomes conspicuous, we can also clearly discover it in many animals; especially

especially in such, as like this kind of moss, possess the advantages of a rapid growth, and great transparency of texture. This is the case with the armed polypi, which on account of the miracles they are capable of performing, have within these last forty years been an object of general surprise, and admiration. All the known species of this animal have a kind of gelatinous body, which, whether it be of a green, yellow or brown colour, &c. is still sufficiently transparent to be capable of being distinctly seen through, if a proper lens and light be employed. Its texture is uniform, and simple, and so homogenous, consisting entirely of gelatinous points, which seem to be kept together by a still thinner jelly, that nothing seems concealed from or obscured to the eye of the observer. Now, when this animal is about to produce its young, a swelling or tumefaction takes place on a single spot of its body; and from this swelling there shoots out first the cylindrical body, and then the tentaculæ of the young polypus. These are all of so considerable a size as to be observed with the
naked

naked eye: and when we consider this circumstance, and all the others already mentioned, there does not appear the smallest probable ground for supposing, that an organized germ had pre-existed there, and was now evolving.

I refer it to the internal feelings of every one who has attentively observed this kind of production in animals, and plants of so simple a texture as those alluded to, and who at the same time have well attended to all the arguments brought forward in the foregoing section against the doctrine of the pre-existence of the embryo of the chick in the yolk of the egg, whether in passing in his own mind to the generation of the more perfect or warm-blooded animals (as for instance by the most accurate investigation of the phenomena of the beginning, progress, and form of the embryo in the fecundated egg, and also of the many other parts^(h) which are

(^h) *Nidus pulli, bulla amnion, figura venosa, &c.*

never

to be found in the unfecunded one) whether, I say, his conviction leads him to believe in the pre-existence of enveloped organic germs ; or, in the existence of a *nifus*, by which a new being is formed from the unorganized materials of generation.

All the arguments which have hitherto been deduced from the phenomena of generation in support of the existence of a *Nifus Formativus*, gains new, and additional weight from the consideration of the phenomena of *reproduction*; this so wonderful power of organised bodies by which lost, and mutilated parts are again renewed.

Generation, and reproduction are both modifications of one, and the same power ; the last being nothing else than a partial repetition of the first. Whatever tends to elucidate the one, must therefore throw light on the other.

I have

I have frequently repeated the experiments alluded to in the First Section, by which I endeavoured to discover the power of reproduction in the green armed polypus, and have constantly met with the same success. The little mutilated animal was always diminished in bulk, in proportion as its new arms or new body were pushed out. It became evident with what efforts nature hastened to renew the determinate form of the maimed animal, and also, that from the short period of time, and the improbability of the polypus having taken a sufficient quantity of nourishment to supply materials for the new members (since all wounded polypi eat less than usual); From these circumstances I say, it became evident, that owing to the force of the *Formative Nisus* with which the parts were endowed, the remaining portion of the mutilated animal, was in some degree, converted into the new members, and thus the disturbed structure renewed.

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I am well aware, that the advocates for the theory of Evolution, will, in order to help themselves out of this difficulty, have recourse to an hypothesis, which of all improbable ones, may be stiled the most romantic, and improbable; and according to which it is supposed, “ That in every part of
 “ the polypus, there exists innumerable germs
 “ enveloped, and torpid as it were, which
 “ lie like a hidden store, untill it shall please
 “ the fancy of a naturalist to rouse them
 “ into action, and free them from their state
 “ of imprisonment, by the enlivening cut of
 “ a pair of scissars.”

Now, let any one compare this explanation with the naked appearances which take place in the above, and many other experiments on the armed polypus, the process of which are so easy to be discovered.—I shall at present content myself with relating two of these experiments. When we take the half of two polypi of different kinds, for instance,
 the

the anterior half of a green one, and the posterior half of a brown one, and bring them together at the bottom of a proper glass, they join together, and form in this manner, one of these monsters of mythology, representing a group composed of different parts of different animals.

According to the theory of Evolution, however, very different phenomena must have occurred. Instead of this junction between the two halves, each one ought to have evolved from an organic germ that part of which it had been deprived of; but this is not what we observe; it was more natural that the two parts should join by the means of their formative powers, than that each of the halves should of itself have been metamorphosed to a complete animal by the manner described above.

There is a well known experiment however, which is admirably calculated to demonstrate both the improbability of the supposed

posed pre-existing germs, and at the same time, the activity of the *Formative Nifus*. When we take the polypus, and do not divide it in pieces, but merely slit open its belly longitudinally, so as to destroy that cavity; and as it were, metamorphose the shape of the animal from a cylindrical to a flat form; instead of a number of organic germs being set free from the cut edges, and of their being each evolved, one of the two following occurrences takes place; either the animal rolls itself together in the usual form, so that the edges of the wound meet and coalesce, or if it remains like a piece of flat tape, it begins soon after to swell in the middle, as if it were blown up, and there is gradually formed within it a new belly.

In both these cases there is no occasion for new *materials*, all that is done is a mere *reparation* of the *disturbed structure*.

In man and other warm-blooded animals the power of reproduction is much more limited;

mitted not only on account of the great diversity of materials of which they are composed, but also the different quantity of living principle peculiar to each of these materials, and by the mutual dependance and action which they exercise on each other. And yet we often observe in them evident marks of this power of reproduction, tending to confirm all that has been said on this head, concerning the polypus; nails have been observed to grow on the stump of a finger, even although the first joint was completely lost ⁽ⁱ⁾. It would be rather a bold conjecture to suppose that nature had foreseen such accidents, and had therefore sown all the fingers and toes with the organic germs of nails, &c. And on the contrary, how agreeable to nature is it to deduce the whole phenomenon from the activity of the formative powers, whose efforts are sufficiently strong to reproduce nails on the extremities of the fingers, nay even in unusual parts.

(i) *Pecklin and Talp have seen instances of this kind.*

Another equally well known, and interesting fact of this kind, is, where nature endeavours to supply the loss of an extremity, whose complicated structure it would have been difficult for her to restore, by the production of a more simple and uniform substance. Thus, that celebrated surgeon, Morand, gives the description of a hare, which, a considerable time before its death, had had one of its fore legs shot off, the place of which nature had endeavoured to supply with a kind of bony stump, which, although not like the original, *quoad materiem*, yet resembled *taliter qualiter quoad formam*^(k).

If, as I flatter myself, the few phenomena of generation, and reproduction already taken notice of, are sufficient to prove the un-

(k) “ C’etoit,” to use his own expression “ une espèce de jambe de bois, dont la nature seule avoit faet le pais.”

deniable existence of the *Formative Nifus*, there remain many others tending to explain its *modus operandi*; and to ascertain some of the laws by which that mode seems to be regulated. I look upon the following to be of this kind, that is, as the mere result of undoubted observation.

I. *The activity of the Nifus, is, in an inverse ratio, to the age of the organized body.*

For however certain it may be, as has been formerly remarked, that some time is necessary before the first marks of the new conceived fruit becomes visible, yet it is equally well ascertained, that after this interval, the formation proceeds with astonishing celerity.

In general, the embryos of the earlier months are represented in a very unshapely form, but this may be owing either to the person who gives the representation; or to this, that such abortions generally suffer much by external violence, are squeezed, compressed,

or from putrefaction having already begun, lose much of their uncommon elegance, which otherwise render them objects of admiration. I possess some of these beautiful human foetusses of the first months of pregnancy, especially those which I received from my dear friend Mr. Bückner of Gotha, where in one of five weeks old, and of the size of a common bee, all the features of the face, every finger complete, every toe, and the organs of generation were to be distinctly seen.

Now this early activity of the Formative Nifus, is by no means confined to the external form of the embryo, but is still more remarkable in the internal structure. I have often been astonished at the early perfection of the viscera, which I have discovered in dissecting recent human embryos of the first months. Thus, merely to mention one circumstance in its head, which was hardly larger than a pea, the whole cartilaginous *basis cranii*, with all its depressions, apertures, and processes, were marked in the most sharp and distinct manner,

manner, although, indeed, there was not the smallest point of ossification, either in the sphenoid bone, or the petrous part of the temporal one.

However difficult it may be on the supposition of pre-existing germs, to explain what becomes of them for so long a time after they arrive at the place of their destination, and are fecundated and stimulated to evolution; it is equally difficult to imagine, why immediately after this interval, they should so suddenly acquire so respectable a size. On the contrary, after it has been fully understood, what was said concerning the time necessary for the preparation of the fluids of generation, before the Formative Nifus takes place; there remains nothing puzzling in this, that then the new awakened action should so soon form the ground work of the new animal.

That the inverse ratio between the Formative Nifus, and the increase of age,

continues even after birth, is proved by the remarkable ease with which reproduction takes place in very young animals, especially those of the lizard kind, as in the common newt.

II. *The Formative Nifus is much more active in the embryos of mamalia, than in those of oviparous animals.*

In the chick for instance, the first appearance of the ribs is observed one hundred and twenty-nine hours after impregnation. This period is equal to the nineteenth week of gestation in the human species. But I have in my possession, human fœtusses, which are not more than six weeks old, and yet in which, the cartilaginous rudiments of the ribs are to be distinctly discovered. It would appear as if nature made greater haste with the formation of viviparous animals, to secure them against deformity, from accidental causes, such as pressure, external violence, &c. from which causes all oviparous animals are defended by their shell.

III. *In*

III. *In the formation of some particular parts of any organized body, the Formative Nisus is much more regular in its process, than in that of others.* Thus the brain, says old Conr. Vict. Schneider, a man much distinguished in physiology, is seldom or never found to deviate from the usual structure⁽¹⁾. On the contrary, how great and frequent are the variations in many other parts, such as in the kidneys, and Thoracic Duct, &c.

Amongst the many deviations of the formative process from its usual course, these are principally to be mentioned.

1st, *Where one species of organic body takes on the action of that of another.*

To this belong some of the most unaccountable phenomena in nature, which, as

(¹) “*In corpore humano,*” he says, “*nulla pars faciem suam varius mutat quam cerebrum.*”

far as I am able to judge, cannot be explained in any satisfactory manner by the theory of pre-existing germs. It is a well-known fact, that women have in general, and according to the strict laws of nature, only one uterus for the reception of the new conceived foetus. But that most of the other females in the class of mamalia, have a double one. Yet instances are not wanting, where a real *uterus bicornis* has been found in women. This singularity, if I am not mistaken, is accounted for by the previous reflection. In the same manner, I would reckon all those hares, which have been so frequently observed with small horns like those of deers, and also many of those strange deviations, which take place now and then in the structure of the vegetable kingdom, such as the alder-tree with oak leaves, described by Gleditch^(m).

(m) *Betula alnus quercifolia* vid. Gleditch hinterlassene Abhandl. das praktische Fortwesen betreffend.

2dly, *Where the organs of generation of one sex take on more or less the structure of that of the other.*

In our sceptical days, the possibility of human hermaphrodites, and that of other warm-blooded animals, has been much doubted. And yet Baron Haller of this university, and Mr. John Hunter of London, have instituted, and given relations of the most careful dissections of such animals, especially in the cow, and goat tribes, and which leave no room for further doubts in this matter. It is true, that in none of the instances, the most essential parts of generation, for instance, the male testicles, and female ovaria, were to be distinctly discovered in the same individual. But though the chief form seemed to be always that of one of the sexes, yet there was evidently to be discovered in one part or another, the most unequivocal, though imperfect marks of the organs of the other sex. In general, the male organs lay internally, whilst the external ones had more the resemblance of the female.

3dly,

3dly, *When the formative process does not, as in the former instances, take an action which is FOREIGN, but one that is completely PRETERNATURAL to the individual.*

And yet from an attentive consideration of the astonishing uniformity, which reigns amongst the different kinds of monsters, it would appear as if the causes of the deviation in their formation, was regulated by certain fixed laws. Whoever has seen any considerable number of monsters, or only looked into the loose and wretched compilations of representations of them, can hardly have escaped being struck by the resemblance which unites, even to the most inconsiderable parts, certain species of them, so that the individuals of that species, seem as if they had all been cast in the same mould.

To conclude, there is still one other phenomenon, which the reader is at liberty to explain, either on the principle of pre-existing organic

organic germs, or that of the Formative Nifus. Many animal monsters, such for instance, as those with two bodies and a single head, are of that kind, according to the express assertion of Baron Haller, and other evolutionists, that they cannot have arisen from the accidental growth of two germs, but that the fault lies in the original monstrosity of a single germ. Now it is singular, that such monsters are only common in animals which have been domesticated, and that they are never, or at least seldom to be heard of in their wild state. Can the Author of nature have ordained it, that from amongst the involved germs of any one species of animals, for instance, swine, the monsters should arrive at evolution, just when taken under the care of men, and that the monsters should be produced only by the tame, and not by the wild also?

On the other hand, there is nothing unreasonable in supposing, that after the subjection of these animals, their whole frame
and

and œconomy suffer a very great change; that then the Formative Nifus deviates in some degree from its original laws, and therefore these animals as they degenerate into endless varieties, are also more subjected to monstrosity.

Such, in my opinion, are the principal observations and experiments which serve to prove the existence of the Formative Nifus, and to ascertain some of its laws; observations which have drawn my conviction more and more from the system of involved germs, and confirmed my belief in the very opposite doctrine, which I have endeavoured to establish.

F I N I S.

E R R A T A.

Page	line	for	read
5	5	begins,	begin.
29	4 of the Note,	Sonebier,	Senebier.
38	4 of the Note,	oviatur,	oriatur.
42	4	affertes,	afferted.
45	7 of the Note,	Disquisitionum,	Disquisitio num.
71	13	dele	of.

